tion is the best straight line which can be drawn through these points, but that it leaves all the intermediate points on one side of the line. Le Verrier's solution destroys the mean error, but leaves the extreme measures unrepresented. The other value $10''\cdot73$ destroys the mean error for the larger measures. The arbitrary break about $16''$ is seen with all the different adopted values of the diameter at the Sun's mean distance, and shows, I venture to think, that either the same thing is not attempted to be measured when the diameter is about $8''$ as when the diameter is over $16''$, or that some very serious error exists in the calculation of the distance of *Mars*. The last supposition is, I believe, inadmissible to the requisite amount, and we appear, therefore, driven to suppose that the true limb is not seen when *Mars* is very distant from us, but that the measures have reference to the visible boundary of the atmosphere of *Mars*, which is itself not of a very permanent character at varying distances. After $16''$ the measures of the diameter appear more consistent, and from these alone we should obtain

$$10''73 - 0'04 \times i$$

for the value of the diameter at the mean distance : i is the irradiation constant, which can scarcely exceed $0''\cdot5$ for observations of *Mars* with an 8-inch telescope, and may be less. But this value only represents the larger measures, and is certainly not a satisfactory determination of the diameter.

It appears essential that observations of single limbs of *Mars* should be reduced with diameters determined by the same observer, and, if possible, at distances of *Mars* not very different from the distance at the time of observation. I have not examined the Right Ascension observations of diameter, but they are hardly sufficient in number to throw much light upon the question of the supposed sensible variation in the *effective* diameter at different distances.

On the North Polar Distances of the Cape Catalogue for 1840.
By A. M. W. Downing, Esq.

The Cape Catalogue for 1840, published by Mr. Stone in 1878, is deduced from observations made under the direction of the late Sir T. Maclear during the years 1832 to 1840 with the six-feet mural Circles by Jones. The old instrument, erected by Fallows 1828-1829, was used until July 1839, when it was replaced by the new mural Circle, which was mounted in the same position. The zenith points of the mural Circles were determined by direct and reflexion observations of stars at the meridian passage, and it has been usual to adopt results deduced from observations made at intervals extending from a week to a month, according to the stability of the instrument. Corrections for discordance of direct and reflexion observations have been determined by a graphical process and applied.

COMPARISON of the NORTH POLAR DISTANCES of the CAPE CATALOGUES, for 1860 and for 1840.
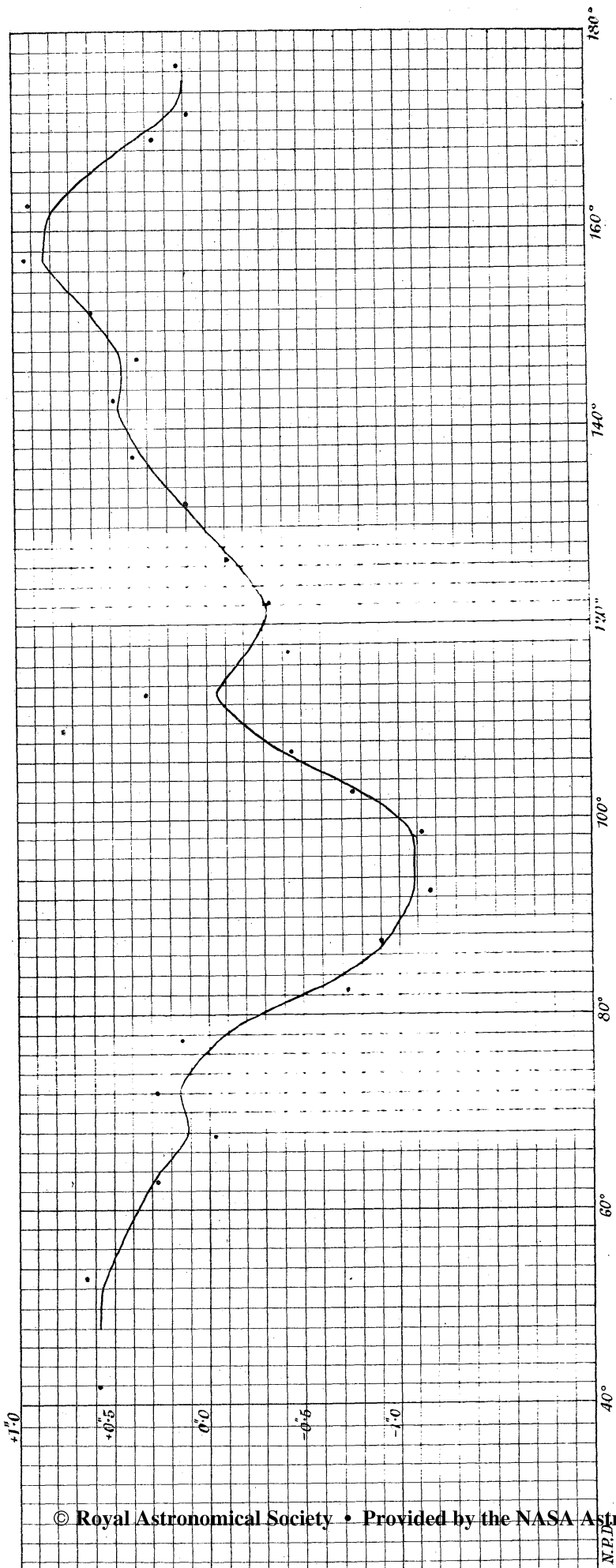
Spottiswoode & Co. Lith. London.

The refractions used in the reductions were those of Bessel's *Tabulæ Regiomontanæ*.

The division errors of the mural Circles do not appear to have been determined. The flexure was considered insensible.

The places given in the Catalogue have been corrected for proper motion in only a few instances; in the present investigation a correction for proper motion has been applied to the Catalogue place whenever it became significant.

The particulars given above have been extracted from the Introduction to the Catalogue written by Mr. Stone; as the work is not yet distributed to the astronomical public, it appeared desirable to reproduce them in this place.

The North Polar Distances of this Catalogue have first been compared with those of the Cape Catalogue for 1860. There are 398 stars available for the comparison, after rejecting those whose places in either Catalogue depend on a single observation. The N.P.D.'s of these, as given in the 1860 Catalogue, were brought back to the epoch 1840 by applying the precessions, secular variations, and generally the proper motions of the 1860 Catalogue. In some instances these proper motions appeared to be erroneous, in which cases what was considered a more correct value was used instead of that given in the Catalogue. The differences between the N.P.D.'s of the 1860 Catalogue thus brought back and those of the 1840 Catalogue were then taken, and having been arranged in order of N.P.D., were combined in groups extending over 5° of N.P.D.; the means of the differences for each group being considered as the difference between the Catalogues for the mean N.P.D. of the group. These mean differences were then laid down as points on cross-ruled paper, and a curve (*see* diagram) drawn through them, which may be taken to represent the systematic differences of the N.P.D.'s of the Catalogues.

The differences as computed and as read off from the curve are as follows :—

N.P.D.	Number of Stars.	1860−1840		N.P.D.	Number of Stars.	1860−1840	
		Means.	Curve.			Means.	Curve.
41 57	3	+ ·57	+ ·57	117 36	40	− ·42	− ·22
53 7	3	+ ·66	+ ·55	122 33	34	− ·35	− ·31
62 16	12	+ ·28	+ ·30	127 16	27	− ·11	− ·12
67 43	22	− ·04	+ ·12	132 21	28	+ ·11	+ ·13
72 3	8	+ ·29	+ ·17	137 20	24	+ ·39	+ ·35
77 49	6	+ ·15	− ·04	142 50	19	+ ·48	+ ·43
82 34	14	− ·72	− ·55	147 29	22	+ ·36	+ ·45
87 3	8	− ·90	− ·92	152 19	19	+ ·60	+ ·63
92 11	4	−1·16	−1·09	157 16	21	+ ·96	+ ·86
98 4	13	−1·13	−1·06	162 55	3	+ ·91	+ ·77
103 0	8	− ·78	− ·79	168 30	9	+ ·27	+ ·38
107 29	15	− ·43	− ·34	171 56	12	+ ·07	+ ·14
112 50	18	+ ·32	− ·06	176 58	6	+ ·14	+ ·14

COMPARISON of the NORTH POLAR DISTANCES of the CAPE CATALOGUES, for 1860 and for 1840.
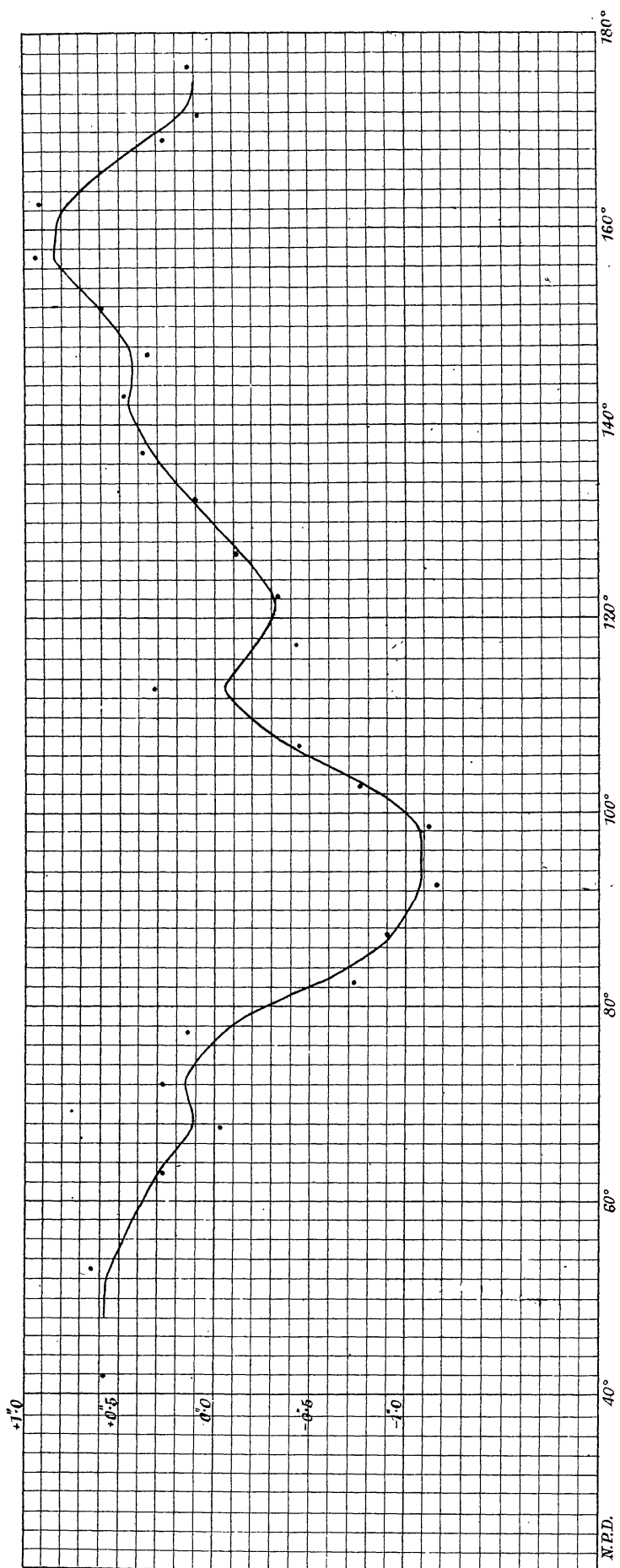
The following table gives the differences for every 4° of N.P.D. as read off from the curve, and also the comparisons with the Greenwich Catalogues for 1860 and for 1840, which are deduced from the table given at p. 172 of Mr. Christie's paper in vol. xlv. of the *Memoirs*.

N.P.D.	Cape 1860 *minus* Cape 1840.	Greenwich 1860 *minus* Cape 1840.	Greenwich 1840 *minus* Cape 1840.
48	+ ·57	+ 1·16	+ 1·03
52	+ ·55	+ 1·12	+ ·88
56	+ ·48	+ 1·02	+ ·64
60	+ ·38	+ ·89	+ ·49
64	+ ·25	+ ·73	+ ·35
68	+ ·13	+ ·59	+ ·27
72	+ ·17	+ ·62	+ ·43
76	+ ·01	+ ·42	+ ·42
80	− ·28	+ ·07	+ ·20
84	− ·69	− ·38	− ·09
88	− ·96	− ·62	− ·24
92	− 1·08	− ·71	− ·27
96	− 1·08	− ·67	− ·17
100	− ·99	− ·58	− ·09
104	− ·70	− ·37	+ ·05
108	− ·30	·00	+ ·23
112	− ·07	+ ·19	+ ·12
116	− ·16	+ ·04	+ ·15
120	− ·29	− ·16	+ ·41
122	− ·32	− ·19	+ 2·08
124	− ·27	− ·09	+ 3·93
128	− ·09		
132	+ ·11		
136	+ ·29		
140	+ ·41		
144	+ ·44		
148	+ ·47		
152	+ ·60		
156	+ ·81		
160	+ ·82		
164	+ ·70		
168	+ ·42		
172	+ ·13		

Comparisons with the other Greenwich Catalogues and with the Melbourne Catalogue can be found at once from the table in Mr. Christie's paper referred to above.

It should be remarked that the Cape and Greenwich Catalogues for 1840 give quite independent results to the Catalogues for the epoch 1860, as different instruments were in use at both Observatories at these dates.

A direct comparison has also been made between the Cape and Greenwich Catalogues for 1840, with results substantially agreeing with those given above. The number of stars used is 281, and proceeding generally as before the computation gives :—

Z.D. at Cape.	N.P.D.	Number of Stars.	Greenwich − Cape 1840 Means.	Greenwich − Cape 1840 Smoothed Means.
$8\overset{\circ}{7}$	$37\overset{\circ}{}6'$	5	$+5\overset{''}{\cdot}59$	$+5\overset{''}{\cdot}59$
$83\frac{1}{4}$	40 49	6	$+2\cdot86$	$+2\cdot86$
$77\frac{1}{2}$	46 26	18	$+1\cdot70$	$+1\cdot70$
$73\frac{1}{4}$	50 45	6	$+0\cdot50$	$+\cdot86$
$65\frac{1}{4}$	58 44	3	$+\cdot76$	$+\cdot63$
$61\frac{1}{2}$	62 35	13	$+\cdot49$	$+\cdot50$
$56\frac{1}{4}$	67 49	26	$+\cdot23$	$+\cdot35$
$51\frac{1}{3}$	72 40	14	$+\cdot43$	$+\cdot42$
$46\frac{3}{4}$	77 11	7	$+\cdot57$	$+\cdot45$
$41\frac{1}{2}$	82 24	17	$+\cdot23$	$+\cdot16$
Z.D. at Greenwich.				
$48\frac{1}{2}$	87 1	11	$-\cdot40$	$-\cdot16$
$53\frac{1}{2}$	92 4	6	$+\cdot01$	$-\cdot13$
60	98 21	17	$-\cdot12$	$+\cdot02$
$64\frac{1}{4}$	102 47	13	$+\cdot29$	$+\cdot15$
69	107 22	24	$+\cdot12$	$+\cdot28$
$74\frac{3}{4}$	113 15	24	$+\cdot55$	$+\cdot48$
$78\frac{1}{3}$	117 49	36	$+\cdot69$	$+\cdot69$
84	122 30	13	$+1\cdot56$	$+1\cdot56$
$86\frac{3}{4}$	125 14	22	$+2\cdot81$	$+2\cdot81$

The smoothed means have been obtained by taking the means of every consecutive pair, omitting the two extreme values at each end of the series, and the means of these again; being in fact the same process as has been adopted in drawing the curve for comparison of the two Cape Catalogues.

The most noticeable feature in the comparison of the Cape Catalogues is the large difference in the neighbourhood of N.P.D. 95°; this is not to be attributed to large actual error in either of the Catalogues, as the comparison with Greenwich seems to show that it is about equally divided between them.

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With regard to the question of astronomical refraction, the evidence afforded by this investigation, as far as it goes, seems to confirm the results deduced from the discussion of the N.P.D.'s of the Cape 1860 and Melbourne 1870 Catalogues—viz., that down to about 80° Z.D. the Greenwich observations are satisfactorily represented by the refractions of the *Tabulæ Regiomontanæ*, and that below that limit some such corrections as those proposed by Mr. Main are required. Thus, in the table above, the correction at 84° Z.D. is about $-1''$, and that at $86\frac{3}{4}°$ is about $-2''\cdot5$, and the discordances are then reduced to $+\cdot56$ and $+\cdot31$ respectively. At the same time it will be remarked that the Cape observations near the north horizon appear to require refractions diminished in a larger proportion, and corrections commencing at a less zenith distance than is the case at Greenwich. On this point, however, further investigation is desirable, the materials for which are now, we may hope, rapidly accumulating.

The comparison of N.P.D.'s of principal "Nautical Almanac" stars in the Greenwich and Cape Catalogues for 1840, given in the Introduction to the latter, has been utilised, for the stars situated between N.P.D. 60° and 118°, for the purpose of ascertaining whether there is any outstanding correction depending on the meteorological elements. For this purpose these stars have been combined in groups extending over six hours of R.A., with the result :—

R.A.	0^h–6^h	6^h–12^h	12^h–18^h	18^h–24^h
Greenwich — Cape	$-\cdot02$	$+\cdot08$	$+\cdot53$	$+\cdot22$.

If $+''\cdot10$ be taken as the systematic difference between the Catalogues for the limits of N.P.D. under consideration, we have—

R.A.	0^h–6^h	6^h–12^h	12^h–18^h	18^h–24^h
Greenwich — Cape	$-\cdot12$	$-\cdot02$	$+\cdot43$	$+\cdot12$.

The similarity of this result to that given by Mr. Stone as deduced from his own observations (*M. N.* vol. xl. p. 70) is very striking, and remarking the large relative discordance in the third group—that is, for observations made during May, June and July—tends to confirm his opinion that the complete reversion of the seasons at the northern and southern Observatories is not quite accurately allowed for in the refraction tables.

On the Apparent Conjunctions of the Satellites of Uranus with each other, 1881. By A. Marth, Esq.

When the apparent orbits of the satellites are flat ellipses, as they are at present, the satellites will not rarely pass one another at a short distance. Usually they will come to conjunction by encountering one another while moving in opposite directions